Claims

1. An apparatus for transducing an acoustic signal produced by a source, the signal having a frequency within a range from a low to a high, and corresponding wavelength within a range from a long to a short, the apparatus comprising:

a. an array of at least two pressure sensors spaced apart along a sensor axis and located at an array location;

b. a loudspeaker that is configured to output sound waves in response to an input, at a loudspeaker location that is on the sensor axis;

c. a first signal processor, coupled to an output from the array of pressure sensors, configured to generate a signal that corresponds to an estimate of a pressure derivative approximately along the sensor axis, at the array location; and

d. a second signal processor, having an input that is coupled to an output of the first signal processor, and having an output that is coupled to the loudspeaker input, which second signal processor is configured to generate an output signal that is proportional to the estimate of derivative signal.

2. The apparatus of claim 1, further comprising:

a. a third signal processor, coupled to an output from the array of pressure sensors, configured to generate a signal that corresponds to a weighted source pressure sum;

b. a comparator, coupled to an output of the third signal processor that generates the weighted pressure sum signal, configured to generate a pressure sum error signal that corresponds to whether the pressure sum signal is less than a threshold signal ε; and

c. a fourth signal processor, coupled to an output of the comparator, configured to generate a coefficient signal based on the pressure sum error signal, which coefficient signal is input to the second signal processor which is further configured to generate an output signal that is proportional to the estimate of derivative signal, with a proportionality that is based on the coefficient signal.

3. The apparatus of claim 2, the fourth signal processor configured to generate a coefficient signal that results in the pressure sum being no greater than the threshold signal ε.

4. The apparatus of claim 2, the fourth signal processor coupled to an output of the array further configured to generate the signal that corresponds to pressure sum as a sum of equally weighted outputs of sensors of the array.

5. The apparatus of claim 2, the fourth signal processor coupled to an output of the array further configured to generate the signal that corresponds to pressure sum as a sum of unequally weighted outputs of sensors of the array.

6. The apparatus of claim 1, further comprising a source input portion, the pressure sensor array and loudspeaker arranged such that the loudspeaker is more distant from the source input portion than is the array.

7. The apparatus of claim 6, the array situated such that a second of the pressure sensors is located farther from the source input portion than a first of the pressure sensors, the pressure sensors being spaced apart from each other less than approximately 1/3 the shorter wavelength of the frequency range.

8. The apparatus of claim 6, the source input portion spaced apart from the loudspeaker less than approximately 1/3 the shorter wavelength of the frequency range.

9. The apparatus of claim 6, the sensor array spaced apart from the loudspeaker less than approximately 1/3 the shorter wavelength of the frequency range.

10. The apparatus of claim 6, the apparatus configured such that the signal generated by the second signal processor also being such that while a source produces sound waves at the source input portion, any sound pressure that radiates away from the source and apparatus is less than sound pressure that would be radiated away, attributable to the source alone, in the absence of the loudspeaker.

11. The apparatus of claim 10, the signal generated by the second signal processor also being such that results in any total sound pressure that radiates away from the apparatus being reduced to less than any sound pressure that would be radiated, attributable to the source alone, in the absence of the loudspeaker, the reduction being to a degree approximately as shown in Fig. 13.

12. The apparatus of claim 10, the signal generated by the second signal processor also being such that any sound pressure that radiates away between 1 and 10 feet (10.5 cm and 3.0 m) from the source and apparatus is less than would be any radiated sound pressure attributable to the source alone, in the absence of the loudspeaker, at corresponding distances.

13. The apparatus for transducing of claim 6, the apparatus configured such that the signal generated by the second signal processor also being such that while a source produces sound waves, at the source input portion, the loudspeaker produces sound waves which, in combination with any acoustic signal produced by the source, is approximately an acoustic dipole.

14. The apparatus of claim 1, the signal generated by the second signal processor also being such that results in a magnitude of the pressure derivative along the array axis at the array exceeding that which would be attributable to the source alone, in the absence of the loudspeaker.

15. The apparatus of claim 1, the second signal processor configured to generate a signal to drive the loudspeaker to draw in volume velocity fluctuations approximately equal to any volume velocity fluctuations produced by a source alone.

16. The apparatus of claim 5, further comprising a source input portion, the pressure sensor array and loudspeaker arranged such that the loudspeaker is more distant from the source input portion than is the array, the weighted pressure sum being chosen to establish a directional sensitivity to the pressure sensor array to discriminate in favor of sound coming from the direction of the source input portion.

17. The apparatus of claim 16, the weighted pressure sum being chosen to establish a cardioid directional sensitivity.

18. The apparatus of claim 16, the array comprising an array of three sensors, the weighted pressure sum being chosen to establish a superdirectivity substantially as shown in Fig. 12.

19. The apparatus of claim 16, the array comprising an array of at least two sensors, the weighted pressure sum being chosen to establish a superdirectivity.

20. The apparatus of claim 16, the weighted pressure sum comprising a frequency dependent weighting.

21. The apparatus of claim 1, at least one of the pressure sensors comprising a microphone.

22. The apparatus of claim 1, at least one of the pressure sensors comprising a hydrophone.

23. The apparatus of claim 1, the second signal processor, configured to generate a signal to the loudspeaker to drive the loudspeaker to output sound waves that are out of phase relative to the source.

24. The apparatus of claim 1, the first signal processor that is configured to generate a signal that corresponds to an estimate of a pressure derivative configured to sample output

from the pressure sensors at a frequency greater than approximately 2.4 times the high frequency of the range.

25. The apparatus of claim 1, the frequency range being from about 200 to about 3000 Hz.

26. The apparatus of claim 1, the source comprising a human talker.

27. The apparatus of claim 1, further comprising, coupled to the second signal processor that is coupled to the loudspeaker input, and is configured to generate an output signal that is proportional to the estimate of derivative signal, a telephone signal generator.

28. The apparatus of claim 1, further comprising, coupled to an output of the first signal processor that generates an estimate of the derivative, a telephone signal generator.

29. The apparatus of claim 1, further comprising, coupled to the second signal processor that is coupled to the loudspeaker input, and is configured to generate an output signal that is proportional to the estimate of derivative signal, a radio frequency transmitter.

30. The apparatus of claim 29, the radio frequency generator comprising a cellular telephone handset.

31. The apparatus of claim 1, further comprising, coupled to an output of the first signal processor that generates an estimate of the derivative signal, a radio frequency generator that comprises a cellular telephone signal generator.

32. The apparatus of claim 29, the radio frequency generator comprising a FRS radio frequency handset.

33. The apparatus of claim 1, further comprising, a wireless landline telephone handset, coupled to one of:

a. the second signal processor that is coupled to the loudspeaker input, and is configured to generate an output

signal that is proportional to the estimate of derivative signal; and

b. the first signal processor that is configured to generate the estimate of derivative signal.

34. The apparatus of claim 1, further comprising a shroud arranged to channel airflow from a source.

35. The apparatus of claim 1, further comprising a support that maintains the array of pressure sensors and the loudspeaker in a fixed spatial configuration relative to each other.

36. The apparatus of claim 35, the support comprising a telephone handset.

37. The apparatus of claim 1, the array spaced apart from the loudspeaker by less than about 1/3 the shortest wavelength of interest.

38. The apparatus of claim 1, the array spaced apart from the loudspeaker by less than about 1/6 the shortest wavelength of interest.

39. The apparatus of claim 1, further comprising a user operable magnitude control to control proportionality of magnitude of the loudspeaker output sound waves relative to that of a source alone.

40. The apparatus of claim 1 the signal processor comprising a user operable phase control to control phase of the loudspeaker output sound waves relative to that of a source alone.

41. The apparatus of claim 39, the signal processor comprising a user operable phase control to control phase of the loudspeaker output sound waves relative to that of a source alone.

42. A telephone handset for transducing a talker's speech, into a telephone transmission, the handset comprising:

a. a housing having a talker signal input portion;

b. an array of at least two pressure sensors, spaced apart along a sensor axis that passes through the talker signal input portion, arranged at an array location;

c. a loudspeaker at a loudspeaker location that is on the sensor axis and more distant from the talker signal input portion than it is from the array location;

d. a first signal processor, coupled to an output from the array of pressure sensors, configured to generate a signal that corresponds to an estimate of a pressure derivative approximately along the sensor axis, at the array location; and

e. a second signal processor, having an input that is coupled to an output of the signal processor that generates an estimate of derivative signal, and having an output that is coupled to the loudspeaker input, which signal processor is configured to generate an output signal that is proportional to the estimate of derivative signal.

43. The handset of claim 42, further comprising:

a. a third signal processor, coupled to an output from the array of pressure sensors, configured to generate a signal that corresponds to a weighted talker pressure sum;

b. a comparator, coupled to an output of the third signal processor that generates the weighted pressure sum signal, configured to generate a pressure sum error signal that corresponds to whether the pressure sum signal is less than a threshold signal ε;

c. a fourth signal processor, coupled to an output of the comparator, configured to generate a coefficient signal based on the pressure sum error signal, which coefficient signal is input to the second signal processor

which is further configured to generate an output signal that is proportional to the estimate of derivative signal with a proportionality that is based on the coefficient signal.

44. The handset of claim 43, the fourth signal processor configured to generate a coefficient signal that results in the pressure sum being no greater than the threshold signal ε.

45. The handset of claim 43, the fourth signal processor coupled to an output of the array further configured to generate the signal that corresponds to pressure sum as a sum of equally weighted outputs of sensors of the array.

46. The handset of claim 43, the fourth signal processor coupled to an output of the array further configured to generate the signal that corresponds to pressure sum as a sum of unequally weighted outputs of sensors of the array.

47. The handset of claim 42, further comprising a talker input portion, the pressure sensor array and loudspeaker arranged such that the loudspeaker is more distant from the talker input portion than is the array.

48. The handset of claim 47, the array situated such that a second of the pressure sensors is located farther from the talker input portion than a first of the pressure sensors, the pressure sensors being spaced apart from each other less than approximately 1/3 the shorter wavelength of the frequency range.

49. The handset of claim 47, the talker input portion spaced apart from the loudspeaker less than approximately 1/3 the shorter wavelength of the frequency range.

50. The handset of claim 47, the sensor array spaced apart from the loudspeaker less than approximately 1/3 the shorter wavelength of the frequency range.

51. The handset of claim 47, the handset configured such that the signal generated by the second signal processor also

being such that while a talker speaks at the talker input portion, any sound pressure that radiates away from the talker and handset is less than pressure that would be radiated away, attributable to the talker alone, in the absence of the loudspeaker.

52. The handset of claim 51, the signal generated by the second signal processor also being such that results in any total sound pressure that radiates away from the handset being reduced to less than any sound pressure that would be radiated, attributable to the talker alone, in the absence of the loudspeaker, the reduction being to a degree approximately as shown in Fig. 13.

53. The handset of claim 51, the signal generated by the second signal processor also being such that any sound pressure that radiates away between 1 and 10 feet (10.5 cm and 3.0 m) from the talker and handset is less than would be any radiated sound pressure attributable to the talker alone, in the absence of the loudspeaker, at corresponding distances.

54. The handset of claim 42, the signal generated by the second signal processor also being such that results in a magnitude of the pressure derivative along the array axis at the array exceeding what would be a magnitude of a pressure derivative along the array axis at the array attributable to the talker alone, in the absence of the loudspeaker.

55. The handset of claim 42, the second signal processor configured to generate a signal to drive the loudspeaker to draw in volume velocity fluctuations approximately equal to any volume velocity fluctuations produced by a talker alone.

56. The handset of claim 46, further comprising a talker input portion, the pressure sensor array and loudspeaker arranged such that the loudspeaker is more distant from the talker input portion than is the array, the weighted pressure sum being chosen to establish a directional sensitivity to the pressure sensor array to discriminate in favor of sound coming from the direction of the talker input portion.

57. The handset of claim 56, the weighted pressure sum being chosen to establish a cardioid directional sensitivity.

58. The handset of claim 56, the array comprising an array of three sensors, the weighted pressure sum being chosen to establish a superdirectivity substantially as shown in Fig. 12.

59. The handset of claim 56, the array comprising an array of at least two sensors, the weighted pressure sum being chosen to establish a superdirectivity.

60. The handset of claim 56, the weighted pressure sum comprising a frequency dependent weighting.

61. The handset of claim 42, at least one of the pressure sensors comprising a microphone.

62. The handset of claim 42, the second signal processor, configured to generate a signal to the loudspeaker to drive the loudspeaker to output sound waves that are out of phase relative to any talker.

63. The handset of claim 42, the first signal processor that is configured to generate a signal that corresponds to an estimate of a pressure derivative being configured to sample output from the pressure sensors at a frequency greater than approximately 2.4 times the high frequency of the range.

64. The handset of claim 42, the frequency range being from about 200 to about 3000 Hz.

65. The handset of claim 42, further comprising, coupled to the second signal processor that is coupled to the loudspeaker input, and is configured to generate an output signal that is proportional to the estimate of derivative signal, a telephone signal generator.

66. The handset of claim 42, further comprising, coupled to an output of the first signal processor that generates an estimate of the derivative, a telephone signal generator.

67. The handset of claim 42, further comprising, coupled to the second signal processor that is coupled to the loudspeaker input, and is configured to generate an output signal that is proportional to the estimate of derivative signal, a radio frequency transmitter.

68. The handset of claim 42, further comprising, coupled to an output of the first signal processor that generates an estimate of the derivative signal, a radio frequency generator that comprises a cellular telephone signal generator.

69. The handset of claim 42, further comprising a shroud arranged to channel airflow from a talker.

70. The handset of claim 42, the array spaced apart from the loudspeaker by less than about 1/3 the shortest wavelength of interest.

71. The handset of claim 42, the array spaced apart from the loudspeaker by less than about 1/6 the shortest wavelength of interest.

72. The handset of claim 42, further comprising a user operable magnitude control to control proportionality of magnitude of the loudspeaker output sound waves relative to that of a talker alone.

73. The handset of claim 42, the signal processor comprising a user operable phase control to control phase of the loudspeaker output sound waves relative to that of a talker alone.

74. The handset of claim 72, the signal processor comprising a user operable phase control to control phase of the loudspeaker output sound waves relative to that of a talker alone.

75. An apparatus for transducing an acoustic signal produced in an acoustic medium by a source, the signal having a frequency within a range from a low to a high, and

corresponding wavelength within a range from a long to a short, the apparatus comprising:

a. an acceleration sensor, located at a sensor location, arranged to sense acceleration of the medium, along a line and to generate a signal that corresponds to acceleration of the acoustic medium along the line;

b. a loudspeaker that is configured to output sound waves in response to an input, at a loudspeaker location that is spaced from the sensor location along the line; and

c. an amplifying signal processor, having an input that is coupled to the acceleration sensor, which amplifying signal processor is coupled to an input of the loudspeaker, and configured to generate an output signal that is proportional to the acceleration signal.

76. The apparatus of claim 75, the acoustic medium acceleration sensor comprising an array of pressure sensors and a derivative sum signal processor, coupled to the array, configured to generate a signal that is proportional to an estimate of a derivative of pressure along the line.

77. The apparatus of claim 75, the acoustic medium acceleration sensor comprising a laser Doppler sensor.

78. The apparatus of claim 75, further comprising:

a. an array of at least two pressure sensors spaced apart along a sensor axis and located at an array location that is spaced from the loudspeaker location along the line;

b. a sum signal processor, coupled to an output from the array of pressure sensors, configured to generate a signal that corresponds to a weighted source pressure sum;

c. a comparator, coupled to an output of the sum signal processor that generates the weighted pressure sum signal, configured to generate a pressure sum error signal

that corresponds to whether the pressure sum signal is less than a threshold signal ε; and

d. a coefficient signal processor, coupled to an output of the comparator, configured to generate a coefficient signal based on the pressure sum error signal, which coefficient signal is input to the amplifying signal processor, which is further configured to generate an output signal that is proportional to the estimate of derivative signal with a proportionality that is based on the coefficient signal.

79. The apparatus of claim 75, the apparatus further comprising a source input portion, and further configured such that the signal generated by the amplifying signal processor also being such that while a source generates sound at the source input portion, any sound pressure that radiates away from the source and apparatus is less than sound pressure that would be radiated away, attributable to the source alone, in the absence of the loudspeaker.

80. The apparatus of claim 75, the signal generated by the amplifying signal processor also being such that results in any total sound pressure that radiates away from the apparatus being reduced to less than any sound pressure that would be radiated, attributable to the source alone, in the absence of the loudspeaker, the reduction being to a degree approximately as shown in Fig. 13.

81. The apparatus of claim 75, the signal generated by the amplifying signal processor also being such that results in a magnitude of the medium acceleration along the line exceeding what would be a magnitude of medium acceleration along the line attributable to the source alone, in the absence of the loudspeaker.

82. The apparatus of claim 75, the amplifying signal processor configured to generate a signal to drive the loudspeaker to draw in volume velocity fluctuations

approximately equal to any volume velocity fluctuations produced by a source alone.

83. The apparatus of claim 78, at least one of the pressure sensors comprising a microphone.

84. The apparatus of claim 78, at least one of the pressure sensors comprising a hydrophone.

85. The apparatus of claim 75, the acoustic medium comprising water.

86. An apparatus for transducing an acoustic signal produced by a source, the signal having a frequency within a range from a low to a high, and corresponding wavelength within a range from a long to a short, the apparatus comprising:

a. an array of at least two pressure sensors spaced apart along a sensor axis and located at an array location;

b. a loudspeaker that is configured to output sound waves in response to an input, at a loudspeaker location that is on the sensor axis;

c. a first signal processor, coupled to an output from the array of pressure sensors, configured to generate a signal that corresponds to an estimate of a pressure derivative approximately along the sensor axis, at the array location; and

d. a second signal processor, having an input that is coupled to an output of the first signal processor that generates an estimate of pressure derivative signal, and having an output that is coupled to the loudspeaker input, which second signal processor is configured to generate an output signal that causes the loudspeaker to draw in any volume velocity fluctuations that are produced by the source.

87. The apparatus of claim 86, further comprising:

a. a third signal processor, coupled to an output from the array of pressure sensors, configured to generate a signal that corresponds to a weighted source pressure sum;

b. a comparator, coupled to an output of the third signal processor that generates the weighted pressure sum signal, configured to generate a pressure sum error signal that corresponds to whether the pressure sum signal is less than a threshold signal ε; and

c. a fourth signal processor, coupled to an output of the comparator, configured to generate a coefficient signal based on the pressure sum error signal, which coefficient signal is input to the second signal processor which is further configured to generate an output signal that is proportional to the estimate of derivative signal with a proportionality that is based on the coefficient signal.

88. The apparatus of claim 87, the fourth signal processor configured to generate a coefficient signal that results in the pressure sum being no greater than the threshold signal ε.

89. The apparatus of claim 87, the fourth signal processor coupled to an output of the array further configured to generate the signal that corresponds to pressure sum as a sum of unequally weighted outputs of sensors of the array.

90. The apparatus of claim 86, the apparatus having a source input portion, further being configured such that the signal generated by the second signal processor also being such that while a source generates sound waves at the talker input portion, any sound pressure that radiates away from the source and apparatus is less than pressure that would be radiated away, attributable to the source alone, in the absence of the loudspeaker.

91. An apparatus for transducing an acoustic signal produced by a source, the signal having a frequency within a

range from a low to a high, and corresponding wavelength within a range from a long to a short, the apparatus comprising:

a. an array of at least two pressure sensors spaced apart along a sensor axis and located at an array location;

b. a loudspeaker that is configured to output sound waves in response to an input, at a loudspeaker location that is on the sensor axis;

c. a first signal processor, coupled to an output from the array of pressure sensors, configured to generate a signal that corresponds to an estimate of a pressure derivative approximately along the sensor axis, at the array location; and

d. a second signal processor, having an input that is coupled to an output of the first signal processor that generates an estimate of pressure derivative signal, and having an output that is coupled to the loudspeaker input, which second signal processor is configured to generate an output signal that causes the loudspeaker to generate a signal which, in combination with the source signal, approximates an acoustic dipole.

92. An apparatus for transducing sound produced by a source at a source location, the apparatus comprising:

a. at least one sensor for measuring an acoustic parameter that corresponds to the sound produced by the source, and generating a signal that corresponds to the measurement;

b. a plurality of sensors for measuring a second acoustic parameter in a plurality of instances, and generating signals that correspond to each instance;

c. a signal processor configured to generate a weighted combination of the signals that correspond to each instance of the second parameter, the weighting being

chosen to establish a directional acoustic sensitivity that discriminates in favor of sound coming from the direction of the source location; and

d. means for controllably, variably, augmenting the first acoustic parameter to reduce the second acoustic parameter below a threshold.

93. An apparatus for transducing sound produced by a talker at a talker location, the apparatus comprising:

a. an array of at least two pressure sensors spaced apart along a sensor axis and located at an array location;

b. a loudspeaker, at a loudspeaker location that is on the sensor axis;

c. a signal processor, coupled to an output from the array of pressure sensors, configured to generate a signal that corresponds to an estimate of pressure derivative, approximately along the sensor axis, at the array location;

d. a signal processor, coupled to an output from the array of pressure sensors, configured to generate a signal that corresponds to a weighted sum of an acoustic parameter at the array location, the weighting chosen to establish a directional sensitivity to the pressure sensor array to discriminate in favor of sound coming from the direction of the talker location;

e. a comparator, coupled to an output of the signal processor that generates a weighted sum signal, configured to generate an error signal that corresponds to a difference between the weighted sum of the acoustic parameter and a threshold ε;

f. a signal processor, coupled to an output of the comparator, configured to generate a coefficient signal based on the error signal, which coefficient signal is

input to a signal generator that has an input that is coupled to an output of the signal processor that generates an estimate of derivative signal and an output that is coupled to the loudspeaker input, the signal generator being further configured to generate an output signal that:

i. is proportional to the derivative signal with a degree of proportionality that is based on the coefficient signal; and

ii. results in the weighted sum of the acoustic parameter being no greater than the threshold ε.

94. An apparatus for transducing an acoustic signal produced by a source, the signal having a frequency within a range from a low to a high, and corresponding wavelength within a range from a long to a short, the apparatus comprising:

a. a pressure sensor located at a sensor location, on a sensor line from a source input portion, which sensor is configured to generate a signal that is proportional to sound pressure;

b. a loudspeaker that is configured to output sound waves in response to an input, at a loudspeaker location that is on the sensor line;

c. a first signal processor, having an input that is coupled to the pressure sensor and having an output signal that is proportional to the pressure signal, which output signal is coupled to:

i. the loudspeaker input; and

ii. a comparator, configured to generate a pressure error signal that corresponds to whether the pressure signal is less than a threshold signal ε; and

d. a second signal processor, coupled to an output of the comparator, configured to generate a coefficient

signal based on the pressure error signal, which coefficient signal is input to the first signal processor, which is further configured to generate an output signal that is proportional to the pressure signal with a proportionality that is based on the coefficient signal.

95. A method for transducing an acoustic signal produced in an acoustic medium by a source at a source location, the signal having a frequency within a range from a low to a high, and corresponding wavelength within a range from long to short, the method comprising the steps of:

a. measuring sound pressure at at least two locations along a sensor axis that passes through the source location, at an array location, spaced from the source location;

b. based on the measured sound pressure, estimating a sound pressure derivative along the sensor axis at the array location, and generating a signal that is proportional thereto; and

c. driving a loudspeaker, located on the sensor axis, spaced away from the source location farther than is the array location, with a signal that is proportional to the estimated sound pressure derivative signal.

96. The method of claim 95, the step of measuring sound pressure comprising measuring sound pressure with an array of at least two pressure transducers.

97. The method of claim 96, further comprising the steps of:

a. generating a signal that comprises a source pressure sum of outputs from the array of pressure sensors;

b. generating a coefficient signal, based on the source pressure sum signal; and

c. wherein the step of driving the loudspeaker, comprises driving the loudspeaker with a signal having a degree of proportionality relative to the estimated pressure derivative, that is based on the source pressure sum signal.

98. The method of claim 97, further wherein the step of generating a signal that comprises a source pressure sum comprises generating a weighted source pressure sum of outputs from the array of pressure sensors, further comprising the steps of:

a. comparing the weighted source pressure sum to a threshold signal ε;

b. generating a pressure sum error signal that corresponds to whether the pressure sum signal is less than the threshold signal;

c. generating a coefficient signal, based on the pressure sum error signal; and

d. wherein the step of driving the loudspeaker, comprises driving the loudspeaker with a signal having a degree of proportionality relative to the estimated pressure derivative, that is based on the pressure sum error signal.

99. The method of claim 98, wherein the step of generating a coefficient signal comprises generating a coefficient signal that causes the loudspeaker to be driven such that the pressure sum signal is less than the threshold signal.

100. The method of claim 98, the step of generating a signal that comprises a source pressure sum comprises generating an equally weighted source pressure sum of outputs from the array of pressure sensors.

101. The method of claim 98, the step of generating a signal that comprises a source pressure sum comprises

generating an unequally weighted source pressure sum of outputs from the array of pressure sensors.

102. The method of claim 98, the step of generating a signal that comprises a source pressure sum comprises generating an frequency weighted source pressure sum of outputs from the array of pressure sensors.

103. The method of claim 101, the step of generating an unequally weighted source pressure sum comprising generating a source pressure sum chosen to establish a directional sensitivity to the pressure sensor array to discriminate in favor of sound coming from the direction of the source location.

104. The method of claim 103, the step of generating a pressure sum chosen to establish a directional sensitivity that discriminates in favor of sound coming from the source location comprising generating a pressure sum chosen to establish a cardioid directional sensitivity.

105. The method of claim 103, the step of generating a pressure sum chosen to establish a directional sensitivity that discriminates in favor of sound coming from the source location comprising generating a pressure sum chosen to establish a superdirective sensitivity substantially as shown in Fig. 12.

106. The method of claim 95, the step of driving a loudspeaker further comprising driving a loudspeaker with a signal that results in any total sound pressure that radiates away from the source and loudspeaker being reduced to less than any sound pressure that would be radiated, attributable to the source alone, in the absence of the loudspeaker.

107. The method of claim 95, the step of driving a loudspeaker further comprising driving a loudspeaker with a signal that results in any total sound pressure that radiates away from the source and loudspeaker being reduced to less than any sound pressure that would be radiated, attributable to the source alone, in the absence of the loudspeaker, the reduction being to a degree approximately as shown in Fig. 13.

108. The method of claim 95, the step of driving a loudspeaker further comprising driving the loudspeaker with a signal that results in a magnitude of the pressure derivative along the sensor axis at the array location, exceeding that which would be attributable to the source alone, in the absence of the loudspeaker.

109. The method of claim 95, the step of driving a loudspeaker further comprising driving the loudspeaker with a signal that causes the loudspeaker to draw in volume velocity fluctuations approximately equal to any volume velocity fluctuations produced by the source alone.

110. The method of claim 95, the step of driving a loudspeaker further comprising driving the loudspeaker with a signal that causes the loudspeaker to generate sound waves which, in combination with any source signal, approximates an acoustic dipole.

111. The method of claim 95, the step of measuring sound pressure comprising sampling sound pressure at a frequency greater than approximately 2.4 times the high frequency of the range.

112. The method of claims 95, further comprising, generating as an electronic output signal a signal that is proportional to the estimated sound pressure derivative signal.

113. The method of claim 112, the step of generating an electronic output signal comprising generating a telephone signal.

114. The method of claim 112, the step of generating an electronic output signal comprising generating a cellular telephone signal.

115. The method of claim 112, the step of generating an electronic output signal comprising generating a radio frequency signal.

116. A method for transducing an acoustic signal produced in an acoustic medium by a talker at a talker location, the signal having a frequency within a range from a low to a high, and corresponding wavelength within a range from long to short, the method comprising the steps of:

a. measuring sound pressure at at least two locations along a sensor axis that passes through the talker location, at an array location, spaced from the talker location;

b. based on the measured sound pressure, estimating a sound pressure derivative along the sensor axis at the array location, and generating a signal that is proportional thereto; and

c. driving a loudspeaker, located on the sensor axis, spaced away from the source location farther than is the array location, with a signal that is proportional to the estimated sound pressure derivative signal.

117. The method of claim 116, the step of measuring sound pressure comprising measuring sound pressure with an array of at least two pressure transducers.

118. The method of claim 117, further comprising the steps of:

a. generating a signal that comprises a source pressure sum of outputs from the array of pressure sensors;

b. generating a coefficient signal, based on the source pressure sum signal; and

c. wherein the step of driving the loudspeaker, comprises driving the loudspeaker with a signal having a degree of proportionality relative to the estimated pressure derivative, that is based on the source pressure sum signal.

119. The method of claim 118, further wherein the step of generating a signal that comprises a source pressure sum comprises generating a weighted source pressure sum of outputs from the array of pressure sensors, further comprising the steps of:

a. comparing the weighted source pressure sum to a threshold signal ε;

b. generating a pressure sum error signal that corresponds to whether the pressure sum signal is less than the threshold signal;

c. generating a coefficient signal, based on the pressure sum error signal; and

d. wherein the step of driving the loudspeaker, comprises driving the loudspeaker with a signal having a degree of proportionality relative to the estimated pressure derivative, that is based on the pressure sum error signal.

120. The method of claim 119, wherein the step of generating a coefficient signal comprises generating a coefficient signal that causes the loudspeaker to be driven such that the pressure sum signal is less than the threshold signal.

121. The method of claim 119, the step of generating a signal that comprises a source pressure sum comprises generating an equally weighted source pressure sum of outputs from the array of pressure sensors.

122. The method of claim 119, the step of generating a signal that comprises a source pressure sum comprises generating an unequally weighted source pressure sum of outputs from the array of pressure sensors.

123. The method of claim 119, the step of generating a signal that comprises a source pressure sum comprises

generating an frequency weighted source pressure sum of outputs from the array of pressure sensors.

124. The method of claim 122, the step of generating an unequally weighted source pressure sum comprising generating a source pressure sum chosen to establish a directional sensitivity to the pressure sensor array to discriminate in favor of sound coming from the direction of the talker location.

125. The method of claim 124, the step of generating a pressure sum chosen to establish a directional sensitivity that discriminates in favor of sound coming from the talker location comprising generating a pressure sum chosen to establish a cardioid directional sensitivity.

126. The method of claim 124, the step of generating a pressure sum chosen to establish a directional sensitivity that discriminates in favor of sound coming from the talker location comprising generating a pressure sum chosen to establish a superdirective sensitivity substantially as shown in Fig. 12.

127. The method of claim 116, the step of driving a loudspeaker further comprising driving a loudspeaker with a signal that results in any total sound pressure that radiates away from the talker and loudspeaker being reduced to less than any sound pressure that would be radiated, attributable to the talker alone, in the absence of the loudspeaker.

128. The method of claim 116, the step of driving a loudspeaker further comprising driving a loudspeaker with a signal that results in any total sound pressure that radiates away from the talker and loudspeaker being reduced to less than any sound pressure that would be radiated, attributable to the talker alone, in the absence of the loudspeaker, the reduction being to a degree approximately as shown in Fig. 13.

129. The method of claim 116, the step of driving a loudspeaker further comprising driving the loudspeaker with a signal that results in a magnitude of the pressure derivative along the sensor axis at the array location, exceeding that

which would be, attributable to the talker alone, in the absence of the loudspeaker.

130. The method of claim 116, the step of driving a loudspeaker further comprising driving the loudspeaker with a signal that causes the loudspeaker to draw in volume velocity fluctuations approximately equal to any volume velocity fluctuations produced by the talker alone.

131. The method of claim 116, the step of driving a loudspeaker further comprising driving the loudspeaker with a signal that causes the loudspeaker to generate sound waves which, in combination with any talker signal, approximates an acoustic dipole.

132. The method of claim 116, the step of measuring sound pressure comprising sampling sound pressure at a frequency greater than approximately 2.4 times the high frequency of the range.

133. The method of claims 116, further comprising, generating as an electronic telephone output signal a signal that is proportional to the estimated sound pressure derivative signal.

134. The method of claim 133, the step of generating an electronic output signal comprising generating a cellular telephone signal.

135. A method for transducing an acoustic signal produced in an acoustic medium by a source at a source location, the signal having a frequency within a range from a low to a high, and corresponding wavelength within a range from long to short, the method comprising the steps of:

a. measuring acceleration of the acoustic medium, along a line that passes through the source location, at a sensor location, spaced from the source location;

b. generating a signal that is proportional to the measured acceleration; and

c. driving a loudspeaker, located on the sensor axis, spaced away from the source location farther than is the array location, with a signal that is proportional to the acceleration signal.

136. The method of claims 135, the step of measuring acceleration comprising the steps of:

a. using an array of at least two pressure sensors arranged along the line generating signals that correspond to pressure;

b. processing the signals that correspond to pressure to generate a signal that corresponds to an estimate of a derivative of pressure along the line.

137. The method of claim 135, the step of measuring acceleration comprising using a laser Doppler transducer.

138. The method of claim 135, further comprising the steps of:

a. using an array of at least two pressure sensors spaced apart along a sensor axis that is collinear with the line, and located at an array location that is spaced from the loudspeaker location along the line;

b. generating a signal that corresponds to a weighted source pressure sum of outputs from the at least two sensors;

c. comparing the weighted source pressure sum to a threshold signal ε and, based on the comparison, generating a pressure sum error signal that corresponds to whether the pressure sum signal is less than the threshold;

d. generating a coefficient signal based on the pressure sum error signal; and

e. generating an output signal that is proportional to the estimate of derivative signal, with a proportionality that is based on the coefficient signal.

139. The method of claim 135, the step of driving the loudspeaker further comprising the step of driving the loudspeaker such that while a source generates sound at the source location, any sound pressure that radiates away from the source and the loudspeaker together is less than sound pressure that would be radiated away, attributable to the source alone, in the absence of the loudspeaker.

140. The method of claim 135, the step of driving the loudspeaker further comprising the step of driving the loudspeaker such that while a source generates sound at the source location, a magnitude of the medium acceleration along the line exceeds what would be a magnitude of medium acceleration along the line attributable to the source alone, in the absence of the loudspeaker.

141. The method of claim 135, the step of driving the loudspeaker further comprising the step of driving the loudspeaker to draw in volume velocity fluctuations approximately equal to any volume velocity fluctuations produced by a source alone.

142. The method of claim 136, the step of measuring pressure comprising measuring air pressure using a microphone.

143. The method of claim 136, the step of measuring pressure comprising measuring water pressure using a hydrophone.

144. The method of claim 135, the acoustic medium comprising water.

145. A method for transducing an acoustic signal produced in an acoustic medium by a source at a source location, the signal having a frequency within a range from a low to a high, and corresponding wavelength within a range from long to short, the method comprising the steps of:

a. measuring, at a sensor location spaced from the talker location, one of:

i. a sound pressure derivative along a sensor axis; and

ii. acceleration of the acoustic medium along a sensor axis; and

b. driving a loudspeaker at a loudspeaker location on the sensor axis spaced from the talker location farther away than is the sensor location, with a signal that is proportional to the one of a sound pressure derivative and acceleration of the acoustic medium, to draw in substantially all volume velocity fluctuations that are produced by the source.

146. The method of claim 145, the step of driving the loudspeaker comprising the steps of:

a. at the sensor location, measuring a sound pressure sum arriving at the sensor location from a direction of the source location;

b. repeatedly adjusting the degree of proportionality while the pressure sum is greater than a predetermined threshold.

147. A method for transducing an acoustic signal produced in an acoustic medium by a source at a source location, the signal having a frequency within a range from a low to a high, and corresponding wavelength within a range from long to short, the method comprising the steps of:

a. measuring, at a sensor location spaced from the talker location, one of:

i. a sound pressure derivative along a sensor axis; and

ii. acceleration of the acoustic medium along a sensor axis; and

b. driving a loudspeaker at a loudspeaker location on the sensor axis spaced from the talker location farther away than is the sensor location, with a signal that is proportional to the one of a sound pressure derivative and acceleration of the acoustic medium, such that, in combination, the loudspeaker and the source approximate an acoustic dipole.

148. The method of claim 147, the step of driving the loudspeaker comprising the steps of:

a. at the sensor location, measuring a sound pressure sum arriving at the sensor location from a direction of the source location; and

b. repeatedly adjusting the degree of proportionality while the pressure sum is greater than a predetermined threshold.

149. A method for transducing sound produced by a source at a source location, the method comprising:

a. measuring a first acoustic parameter that corresponds to the sound produced by the source, and generating a signal that corresponds to the measurement;

b. using a plurality of sensors, measuring a second acoustic parameter in a plurality of instances, and generating signals that correspond to each instance;

c. generating a weighted combination of the signals that correspond to each instance of the second parameter, the weighting being chosen to establish a directional acoustic sensitivity that discriminates in favor of sound coming from the direction of the source location; and

d. controllably, variably, augmenting the first acoustic parameter to reduce the second acoustic parameter below a threshold.